Forgetting "murder" is not harder than forgetting "circle": listwise-directed forgetting of emotional words.

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BRIEF REPORT

Forgetting ''murder'' is not harder than forgetting ''circle'': Listwise-directed forgetting of emotional words

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The list-method directed forgetting (DF) paradigm has attracted the attention of clinical psychologists because it is widely believed that a retrieval inhibition mechanism underlies its effects. Thus, the idea is that people are capable of intentionally forgetting negative emotional material. On the other hand, there are reasons to believe that negative stimuli are relatively resistant to forgetting. The present experiment compared listwise DF of emotional and neutral words in healthy college students. A modified procedure (i.e., a simulated computer crash) showed a reliable DF-effect in that list 1 recall was larger under remember than forget instructions whereas the reverse was true for list 2 recall. Emotionality did not modulate the magnitude of this effect. Thus, negative emotional material is not resistant to forgetting. Although overall, the present findings are in line with a retrieval inhibition interpretation (i.e., decreased access to list 1 material), attentional focusing during list 2 learning may provide a sufficient explanation.

Although some people wish for a perfect memory, it has been suggested that forgetting serves an adaptive goal (Bjork, 1989; Bjork, Bjork, & Anderson, 1998). Indeed, it would be redundant, if not annoying, to remember where one's keys were yesterday when they are in a different place today. Thus, memory needs updating. The mechanisms underlying such an updating ability have been the subject of scientific scrutiny for more than 30

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years (e.g., Golding & MacLeod, 1998). An often used paradigm in this line of enquiry is the directed forgetting (DF) procedure (for a review, see MacLeod, 1998). In the typical experiment, participants are presented with words and are instructed to either remember or forget those words. Contrary to the forget instructions, however, memory for both remember and forget words is tested afterwards. The basic DF effect consists of a decrease in memory performance for forget words, combined with a recall advantage for remember words (see Bjork et al., 1998). This may take the form of a remember-forget difference within participants or of different performance in separate groups of participants receiving either a remember or a forget instruction.

It is important to note that there are two distinct methods for conducting DF experiments. During *item-method* DF, words are presented one by one and each word is followed by a cue to either remember or forget that word. Alternatively, in *list-method* DF participants study a list of words. Halfway through this list they receive a cue that the words must either be forgotten or remembered. Immediately following this instruction, they learn the second half of the word list. Studies directly comparing item and listwise DF (e.g., Basden, Basden, & Gargano, 1993) show that both methods produce the standard DF-effect in free recall, although the effect is smaller with list-method DF. However, whereas the item-method produces a DF-effect in recognition, list-method directed forgetting does not. Based on this pattern of results, it is often suggested (e.g., Bjork et al., 1998; MacLeod, 1998) that different mechanisms underlie list-method and item-method DF. In item-method DF the key mechanism is thought to be selective rehearsal. The idea is that participants keep an item in mind until they see the instruction that tells them what to do with that word. If this cue signals 'remember' they start to elaboratively encode the stimulus word, whereas a cue to forget leads participants to stop further processing the stimulus. In contrast, such a selective rehearsal account cannot easily explain list-method DF effects, because the cue to forget is presented *after* all to-be-forgotten items are presented. Thus, R.A. Bjork and co-workers (see Bjork, 1989; Bjork et al., 1998; Geiselman, Bjork, & Fishman, 1983) proposed a retrieval inhibition mechanism to account for list-method DF. They believe that it is crucial for the acting of retrieval inhibition that both the intention to forget and the learning of new material are present.

Due to this link with inhibition, the DF paradigm has attracted the attention of clinical psychologists, especially those who are interested in the relation between trauma and memory. A commonly voiced view in clinical literature is that abuse survivors are capable of forgetting details of, or even entire traumatic situations (see Cloitre, 1998). Some authors (e.g., Bjork et al., 1998; Cloitre, 1998) suggested that this might be explained by a retrieval inhibition mechanism that turns abuse survivors into skilled forgetters of emotional material. Although a recent study (McNally, Clancy, Barrett & Parker, 2004) showed that abuse survivors do not display superior DF skills, the idea remains that in general, it should be possible for people to inhibit aversive material when they wish to do so (see Conway, 2001; Levy & Anderson, 2002). On the other hand, however, there is good evidence that emotion, and especially its arousal component, exerts a memory enhancing effect (e.g., Bradley, Greenwald, Petry, & Lang, 1992; Cahill, Prins, Weber, & McGaugh, 1994; Doerksen & Shimamura, 2001; Ferré, 2003; Nagae & Moscovitch, 2002). This leads to the prediction that negative emotional material would be harder to forget and that, therefore DF would be impaired.

Thus far, empirical evidence on listwise DF of emotional material is scarce. Although there are a number of DF studies employing emotional words, the majority relied on the item-method (e.g., Cloitre, Cancienne, Brodsky, Dulith, & Perrry, 1996; Elzinga, de Beurs, Sergeant, Van Dyck, & Pfaf, 2000; Korfine & Hooley, 2000; McNally, Clancy, & Schacter, 2001) in which retrieval inhibition is less likely to play a role. As far as we know, there are only a few list-method DF studies using emotional words. Although the main goal of these studies was to examine DF in special samples (e.g., depressed patients, Power, Dalgleish, Claudio, Tata, & Kentish, 2000; recovered memory participants; McNally et al., 2004; repressive copers, Myers, Brewin, & Power, 1998; Myers & Derakshan, 2004), control group data are informative for the present purpose. To begin with, sometimes a larger DF-effect for negative than for positive words is reported (Myers & Derakshan, 2004; Power et al., 2000). In contrast, McNally and co-workers (2004) found no difference in the magnitude of DF-effects for positive and trauma-related words. Furthermore, visual inspection of the control group data of Myers et al. (1998; figs. 1 and 2) suggests a smaller DF-effect for negative than positive words, yet no formal statistical test was reported. It should be noted that these studies all compared negative and positive words, and thus are silent about the question of whether DF has a differential effect for emotional and neutral material. A recent study (Barnier, Conway, Mayoh, & Speyer, 2005) on DF of autobiographical memories included neutral material. Whereas the standard DF effect was obtained for neutral memories, DF of negative memories was unsuccessful.

Taken together, studies on listwise DF of emotional material provide a mixed pattern of results. This leaves the question of to what extent the valence of to-be-forgotten words influences DF in healthy individuals. The present experiment addressed this question, employing a listwise DF procedure comparing negative and neutral words. Two possible outcomes were anticipated. First, if stronger encoding and subsequent enhanced memorability of emotion words renders forgetting more difficult, then the DF effect for negative words should be smaller or even absent relative to neutral words. Alternatively, if retrieval inhibition also acts on emotional material (cf. Levy & Anderson, 2002), then the DF-effects for negative and neutral material should be of comparable magnitude.

METHOD

Participants

Participants were 104 undergraduate students at Maastricht University. They were assigned to one of four conditions:[1] Remember-Emotional (RE; n = 23), Remember-Neutral (RN; n = 29), Forget-Emotional (FE; n = 25) and Forget-Neutral (FN; n =27). They received either course credit or 5 euros for their participation.

[1] Although DF studies relying on emotional stimuli generally include valence as a within-subjects factor (e.g., Myers et al., 1998; Power et al., 2000), the present experiment used emotionality as a between-subjects factor. The reason is that, based on pilot studies, we suspected that including multiple valence category labels across lists might promote inter-list integration for each category during encoding, or alternatively, provide participants with a retrieval strategy during recall.

Stimuli and apparatus

Thirty neutral and 30 negatively valenced stimuli were selected from the Dutch normative list by Hermans and de Houwer (1994) and from stimulus material used in earlier pilot studies. For each valence category two 15-word lists were constructed (A and B for neutral words; C and D for negative words, see Appendix). The learning phase of the experiment (see below) was conducted using a notebook computer. Experimental stimuli appeared in the centre of the computer screen in yellow lower case letters against a grey background. A beamer projected this image on a screen in front of a classroom. List order (A/B; B/A or C/D; D/C) was counterbalanced. Within each list, words were presented randomly and one at a time for a duration of 3 s. Interstimulus intervals were 5 s.

Memory tasks

As a Free Recall test, participants were given a sheet of paper with the printed instruction to write down as many words as they could remember, regardless of whether they received instructions to forget. In addition, participants received a paper-and-pencil forced choice (''yes''/''no'') recognition test. The test contained the 30 words that were presented during the learning phase, mixed with 30 distracter words (Hermans & de Houwer, 1994).

Procedure

Participants were tested in small groups ranging from ranging from 3 to 13 individuals. Participants were informed that the objective of this experient was to assess people's ability to memorise words. They were instructed to concentrate and learn words that appeared on the screen in front of the classroom for the purpose of later memory testing. After presentation of the first word list, a staged computer crash occurred (see also Behrendt & Hasselhorn, 1998).[2] More specifically, the screen suddenly went black and the computer produced an ongoing 1000 Hz tone. The experimenter feigned surprise, tried pressing some keys, checked the computer cables, and eventually rebooted the computer. Participants were told that this event was very unfortunate, but that they could save the experiment by repeating the learning phase with different words. Furthermore, participants in the Forget Condition were instructed to forget the previous word list and concentrate on learning the new words. In contrast, participants in the *Remember Condition* were told to try to remember both word lists. Next, the second word list was presented. After the second learning phase, a short filler task was introduced. For this purpose, participants engaged in an unrelated nonverbal concentration task for 3 min.

[2] There are two ways of administering a forget instruction (Bjork et al., 1998). The first and most commonly used is telling participants after first list learning that this list was just for practice. The second has been referred to as the ''whoops'' procedure and consists of telling subjects that the experimenter made a mistake and that the wrong list was learned (e.g., Wyer & Unverzagt, 1985). Pilot work in our laboratory showed that ''just for practice'' forget instructions rendered results similar to remember instructions (i.e., better list 1 recall than list 2 recall), whereas our variant of the ''whoops'' procedure resulted in a reliable DF-effect. Details of these pilot experiments may be obtained from the first author.

Next, the Free Recall test was administered. Participants in the Forget Condition were explicitly instructed to ignore the previous instruction to forget the first word list. There was a time limit of 5 min to this Free Recall task. Participants then completed the recognition task, for which there was no time limit. Finally, they were debriefed and paid for participation.

RESULTS

First, proportions correct free recall and recognition were calculated for each list-half. Table 1 gives the relevant means and standard deviations. Proportions were subjected to separate 2 (valence: neutral vs. negative) $\times$ 2 (instruction: forget vs. remember) $\times$ 2 (list half: I vs. II) ANOVAs with repeated measures on the last factor.

Regarding *free recall*, a significant main effect of list-half was observed, $F(1, 100) = 5.65$, $p < .05$. The instruction by list-half interaction effect was highly significant $F(1, 100) = 29.85$, $p < .001$. Paired *t*-tests revealed that the overall difference between the first and second list-half was highly significant under remember instructions, $t(51) = 6.47$, $p < .001$, and reached borderline significance for participants who were instructed to forget, $t(51) = -1.98$, $p = .05$. Between-group comparisons showed that the remember group recalled more list 1 items than the forget group, $t(102) = 5.23$, $p < .001$, and that the forget group recalled more list 2 items than the remember group, $t(102) = -2.64$, $p < .05$. All effects involving valence remained nonsignificant, all *F*s < 0.62.

As for *recognition*, the ANOVA revealed a highly significant main effect of list-half, $F(1, 100) = 43.25$, $p < .001$, indicating that more list 1 than list 2 items were recognised. All effects involving instruction and valence were nonsignificant, all *F*s < 2.15. Taken together, the results indicate that a Directed Forgetting effect was obtained for free recall, but not for recognition. Word valence did not influence the magnitude of the DF-effect.

TABLE 1
Proportions correct free recall and recognition per list-half for neutral and negative stimuli under Remember and Forget conditions: means and (standard deviations)

	Remember		*Forget*	
	Neutral (n = 29)	*Negative* (n = 23)	*Neutral* (n = 27)	*Negative* (n = 25)
Free recall				
First List	0.58 (0.18)	0.53 (0.13)	0.40 (0.14)	0.40 (0.18)
Second List	0.39 (0.17)	0.37 (0.13)	0.46 (0.22)	0.48 (0.16)
Recognition				
First List	0.89 (0.14)	0.86 (0.11)	0.86 (0.11)	0.86 (0.14)
Second List	0.79 (0.18)	0.75 (0.16)	0.79 (0.16)	0.77 (0.14)

DISCUSSION

The present experiment used a staged computer crash to study list-method directed forgetting in normal college students. Overall, DF was observed in free recall but not in recognition. In addition, DF of negative and neutral words occurred to a similar extent. Thus, the expectation that the DF effect for negative words would be smaller than for neutral words was not confirmed. Even though this is a null result, we believe that there are good reasons to take it seriously. To begin with, the overall pattern of results is in line with earlier work on DF of neutral words using the list method (e.g., Basden et al., 1993; Geiselman et al., 1983). Furthermore, inspection of the magnitude of the list 1-list 2 differences in the forget groups (Table 1, right panel) gives no reason to suspect that numerically, the expected valence effect was present but failed to reach a significant level due to power issues. If anything, the difference between list 2 and list 1 recall in the negative forget group was slightly *larger* (2%) than in the neutral forget group. Therefore, the present findings lend no support for the idea that emotionality per se provides a boundary condition in list-method DF.

In addition, we found similar overall recall performance for negative emotional and neutral words. Although there is substantial evidence that memory benefits from emotion (see Ferré, 2003), much of this evidence comes from studies that rely on pictorial stimuli that elicit a variety of physiological responses (e.g., Bradley et al., 1992; Cahill et al., 1994). One general account of these effects holds that the release of catecholamines in the amygdala results in a stronger memory representation of such stimuli (Cahill & McGaugh, 1998). It is evident that emotional words are only a weak derivative of the often gruesome slides (e.g., Bradley et al., 1992) that are used in that type of study and thus, amygdala involvement is less likely. Furthermore, studies showing a beneficial effect of emotion on word recall employed encoding procedures that were relatively shallow (e.g., flashing words for 180 ms, Nagae & Moscovitch, 2002; memorising colour rather than word content, Doerksen & Shimamura, 2001) or directed at the emotional valence of the stimuli (e.g., pleasantness ratings, Ferré, 2003). Such procedures are likely to invite a different type of processing than the elaborative encoding that may be expected when participants try their best to memorise stimuli for later recall testing in a DF experiment. Thus, regarding word stimuli, it may be that encoding activities aimed at processing the emotional valence of those stimuli provides the best opportunity for recall differences between emotional and neutral material to surface (see Ferré, 2003). In contrast, more elaborative processing may give neutral words room to catch up, thus levelling out any recall advantage for emotional stimuli.

The question arises of what mechanism is responsible for the DF-effect in the current experiment. The acting of retrieval inhibition is generally inferred from a forget-remember difference within participants (e.g., Basden et al., 1993; MacLeod, 1998). Strictly speaking, although the majority of our between-groups comparisons showed convincing differences, the within-subjects list 1-list 2 difference was of a modest magnitude in the forget group. By contrast, the list 1-list 2 difference in the remember group was much more pronounced and in the opposite direction, strongly reminiscent of proactive interference effects. It seems that if an inhibitory mechanism was at work, it mainly took the form of barring detrimental effects of prior list 1 learning in the forget group. In this light, it seems questionable whether retrieval inhibition, in the strong sense of activation suppression of to-be-forgotten material (Bjork, 1989; see also Anderson &

Spellman, 1995), is a necessary assumption to explain the present set of results. An interesting suggestion comes from the line of reasoning voiced by Conway and co-workers (Conway, Harries, Noyes, Racsma'ny, & Frankish, 2000). Drawing on R.A. Bjork's (1989; Bjork et al., 1998) observation that second list learning is absolutely necessary to obtain listwise DF effects, these authors propose that the focusing of attention during list 2 learning is the driving force for inhibitory effects to occur. In short, they suggest that when the two lists are considered competitors for later recall (e.g., due to a forget instruction), attentional resources are devoted exclusively to list 2 learning, thereby inhibiting list 1 memory. Alternatively, under remember instructions there is no need to keep list 1 memory out of awareness during new list learning, and encoding efforts are directed at the integration of both lists. Perhaps this latter strategy was responsible for the relatively poor list 2 recall in our remember groups.

Whatever the precise underlying mechanism, it is clear that remember and forget instructions resulted in differential recall of list 1 and 2 material in the present studies, and that this occurred to a similar extent for emotional and neutral material. As for this latter finding, one might counter that our set of negative words was not sufficiently emotional. However, our negative stimuli are similar to those used in earlier work (e.g., Nagae & Moscovitch, 2002) and care was taken that the sets of negative and neutral words differed with regard to emotionality. However, one could question the extent to which our negative stimuli were truly emotional to *a college student population*. Consider again Conway's (Conway et al., 2000) suggestion that attentional processes are an important determinant of inhibitory effects in memory. Put in these terms, college students appeared to have no problems with focusing their resources exclusively on list 2 learning, perhaps because list 1 emotional material had no particular intrusive quality for them. Yet, such a view would predict relatively small or absent listwise DF effects in clinical populations who are particularly prone to attention-disruptive influences during list 2 learning when disorder-specific, and thus rather emotional stimuli are presented as list 1 stimuli. Rather than depressed patients (see Power et al., 2000), the most likely candidates for showing such disrupted DF would be anxiety-disordered patients. There is an extensive literature demonstrating that anxiety-disordered patients have difficulties with ignoring the content of threatening stimuli in a modified Stroop paradigm, whereas evidence for such an attentional bias in depression is mixed (see Williams, Watts, MacLeod, & Mathews, 1997). Thus, demonstrating disrupted listwise DF in clinically anxious populations might provide an interesting future test of the idea that attentional focusing is important for triggering inhibitory processes. For now, the results of the present experiment indicate that list-method DF occurs to a similar extent for emotional and neutral words in normal participants.

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APPENDIX

Neutral and negative words (and their English translations) employed in each list of the Directed Forgetting task

Neutral words		*Negative words*	
List A	*List B*	*List C*	*List D*
Accent (Accent)	*Antilope* (Antelope)	*Angst* (Fear)	*Braaksel* (Vomit)
Evenwicht (Balance)	*Boog* (Arch)	*Bedreiging* (Threat)	*Crisis* (Crisis)
Gist (Yeast)	*Cirkel* (Circle)	*Bommen* (Bombs)	*Graf* (Grave)
Inkt (Ink)	*Golf* (Wave)	*Dief* (Thief)	*Haat* (Hate)
Kapper (Hairdresser)	*Hek* (Fence)	*Gebrek* (Failing)	*Hel* (Hell)
Klei (Clay)	*Informatie* (Information)	*Gevaar* (Danger)	*Jaloezie* (Jealousy)
Mand (Basket)	*Kruid* (Herb)	*Gezwel* (Tumour)	*Leugenaar* (Liar)
Pool (Pole)	*Lijn* (Line)	*Incest* (Incest)	*Moord* (Murder)
Procent (Percent)	*Maand* (Month)	*Lijk* (Corpse)	*Ongeluk* (Accident)
Straling (Radiation)	*Merk* (Brand)	*Pijn* (Pain)	*Oorlog* (War)
Streep (Stripe)	*Raadsel* (Riddle)	*Revolver* (Revolver)	*Sadist* (Sadist)
Taken (Tasks)	*Slager* (Butcher)	*Schuld* (Guilt)	*Straf* (Punishment)
Tijd (Time)	*Tekst* (Text)	*Slachting* (Slaughter)	*Verkrachting* (Rape)
Vierkant (Square)	*Theorie* (Theory)	*Stank* (Stench)	*Wraak* (Revenge)
Vraag (Question)	*Vergelijk* (Agreement)	*Vijand* (Enemy)	*Ziekte* (Disease)